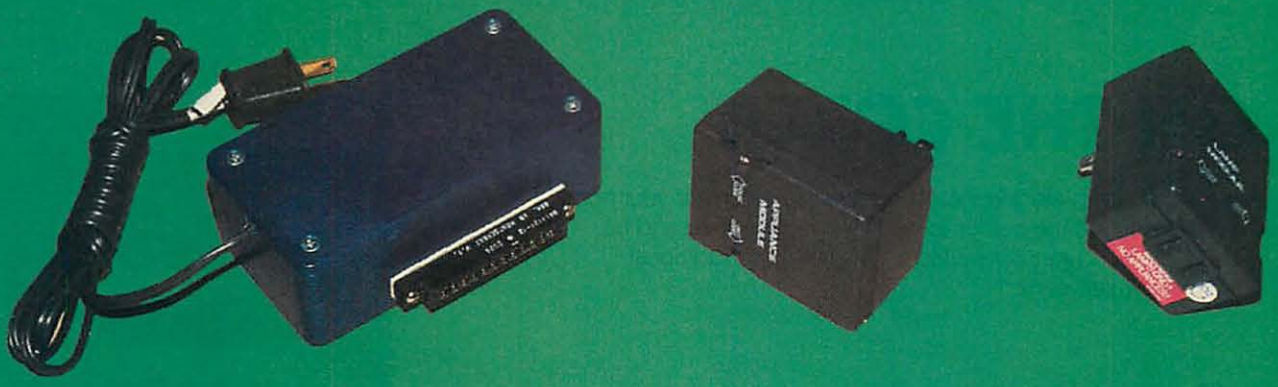
VOL. 3 NO. 5 May 1986

# COMPUTER DIGEST

A NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

## REMOTE POWER CONTROLLER
### For The Commodore-64



## ADAPTING THE TI99-4A KEYBOARD
### To The Sinclair ZX-81

A GERNSBACK PUBLICATION

## USING YOUR COMPUTER
### To Select Power Supply Components

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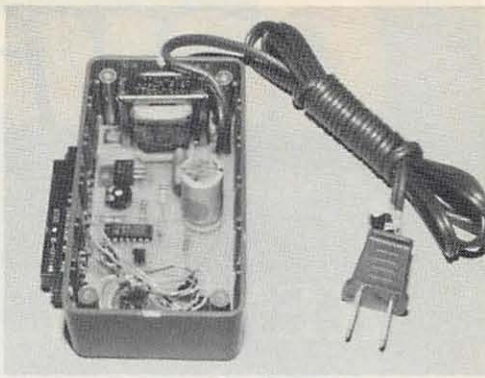

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**7 Using A TI-99/4A Keyboard On A Sinclair ZX-81**
All it takes is a little simple modification, some fancywork with your soldering iron, and you've got it cold. **Robert Grossblatt**

**11 Your Commodore-64 Can Remote Control Your Home.**
With this small circuit and a bit of ingenuity, you can totally computerize your dwelling place. **Chandler Sowden**

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Cut-and-try becomes a thing of the past as you feed the parameters into your computer using this handy program. It picks the components for you! **By Jack Cunkelman**

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## ON THE COVER

Here's the completed Remote Controller to automate your home. We imposed on the author to get his photographed and he couldn't wait to get it installed once again! For additional information, see page 11.

## COMING NEXT MONTH

It's "alphabet soup" time, with a story on GPIB, the General Purpose Interface Buss, and then we've got a story on LAN, Local Area Networking. To round out the issue, you'll be reading a most-interesting piece on what can happen when lightning strikes, as far as your computer equipment is concerned. It happened to one of our authors! Of course, you'll also enjoy all of the regular departments, including our Editorial, the Letters Column, and the latest in Computer Products.

# EDITORIAL

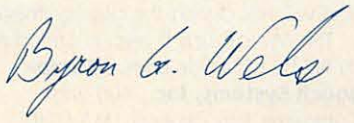
## *Who are you fooling?*

■There are some basic, fundamental tenets in engineering that we are forced to live with. The first of these, is that you "don't get something for nothing." Whatever you gain must be paid for with a sacrifice elsewhere. In computer design, for example, if you want the miniaturization offered by a liquid crystal display, you can't at the same time, have the easy readibility of a cathode ray tube. And if you want low cost you'll usually give up several nice little options that you might also like to have. After all, these things *do* cost money, and somebody has to pay the piper.

A friend of mine called last night to tell me that his new hard disk system was now installed and working. From his enthusiasm, as he read the display, there was no question that he was delighted with the seemingly unlimited workspace he had attained. And the numbers were indeed impressive. Even with his operating systems on the disk, there was still more than ample room left for at least a year's worth of work, and I *know* this guy really cranks it out. Frankly, it left me feeling a trifle envious. It also made me think. The more convenience you build into your system, the less effort you have to exert. Unfortunately, our own "Murphy's Law" that you don't get something for nothing, was working here too. Hard disk systems cost. There are other things we'd like to add to our own system. Things have to be prioritized.

Frankly, I'm as much a sucker for a bargain as anybody else. Offer me a "deal," and you've probably got me hooked. But in retrospect, there are few deals that are worthwhile, and these come far between. You want to buy the most for your money, the seller wants to give as little as possible to improve his own profit picture. Nobody is in business on an altruistic basis. You know how much you've got to spend; the seller knows what he has to offer. He may show you something with fewer of the "extras" that will save you some bucks, and you probably figured to add the extras later on.

That's why we figured out a new version of the Law... "Buy the best you can afford and make your first expense your last."



Byron G. Wels
Editor

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# LETTERS

### More Plus 4

I just acquired a Commodore Plus 4 and can't seem to get any information at all on the unit. Can anybody out there help me?
—F.K., Rowayton, CT.

*F.K., we've gotten a lot of mail on this. It seems that somebody's pushing these units at a low price on TV. We've done a bit of digging around, and suggest that you write to ETT Book Club, Department CD, P.O. Box 240, Massapequa Park, N.Y. 11762. Send 'em $6.50 plus $1.00 shipping and handling, and they'll send you a book on programming the Plus 4 and C-16.*

### Valuable tool

I just wanted to write and say that I count **ComputerDigest Magazine** as one of my more valuable tools. I save every issue and refer to them constantly. Thanks for the good job!—T. J., Oklahoma City, OK.

*Thank YOU T.J. We appreciate the kind words.*

### Moving

I see from your last issue that you've moved or are moving. Will this have any effect on my subscription?—S. L., Taos, N.M.

*No, S. L. By the time you read these words, the move will have been accomplished. Since it's the nature of a magazine to work ahead, we're well backed-up with ready-to-go material, so your issues will continue as though nothing happened.*

### Dilletante?

It seems that interest in electronics comes in waves. First it was hi-fi, then stereo, followed by the CB craze. After that it was computers, and as suddenly, interest shifted to satellite. Magazines suddenly burst out to cater to those interests, the electronic shops stock up for them, and as suddenly, they die out. From where you sit, can you tell me what's coming next?
—P.T., Princeton, NJ.

*Wish I could, P.T. I'd be laying out a new magazine right now! But I don't have a crystal ball either. Incidently, you can eliminate computers from your list of "drop-outs." Because the computer has such enormous practical value to so many, it isn't just a passing fad. We're here to stay!*

### Help?

Can anybody help with a service manual or schematic for a Commodore SX-64? (Not a C-64). I'll pay any reasonable fee for this information. It's not available from Commodore or Sams.—P. S., Boynton Beach, FL.

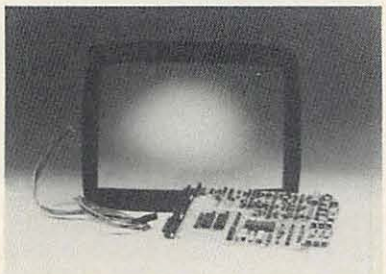
*If you can help, write to Paul Schultz, 9535 Listow Terrace, Boynton Beach, FL 33437.*

# COMPUTER PRODUCTS

For more details use the free information card inside the back cover

**TOUCH SCREEN,** is a 19-inch capacitive touch screen, designed for OEM's and systems integrators, The *MicroTouch Screen* comes fabricated in the standard spherical shape to fit most 19-inch monitors, or in cylindrical form to fit the line of 19-inch Sony monitors. It more than doubles the display area of the 13-inch screen, providing better visibility, greater visual impact, and more touch area to manipulative data.

The *MicroTouch Screen* allows users to interact with the computer intuitively by simply touching images on the CRT screen. The screen operates by automatically sensing the location of a capacitive coupling when it is touched by a finger or conductive stylus. Constructed of solid glass with a resistive coating bonded to its surface, the screen is virtually impervious to damage under normal conditions, and will not distort the display image.



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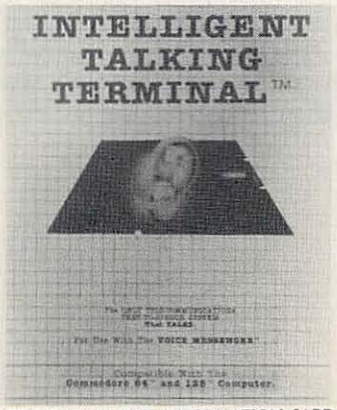
The *MicroTouch Screen* is priced at $1395.00 for single units.—**Microtouch Systems, Inc.,** 400 West Cummings Park, Woburn, MA 01801.

**TALKING MODEM,** the *Intelligent Talking Terminal,* lets the user receive modem-transmitted data verbally, just as if he or she were listening to a telegram on the phone. The user can also receive information the ordinary way: text-on-screen or printed. The *Intelligent Talking Terminal* enunciates data transmitted over phone lines—even if transmitted at high baud rates—and talks in clear, understandable speech.

With a talking modem, one can now read and hear stock market quotes or the latest business news. It can also be tapped into a wide range of other library data bases for educational, research, and reference materials, financial information, or news updates.

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The *Intelligent Talking Terminal* has a suggested retail price of $29.95.—**Welwyn Currah,** 104 W. Fourth Street, Royal Oak, MI 48067.

# SOFTWARE REVIEW

## *WORD FINDER—An Electronic Thesaurus.*

■Depending on how it's used, a word can be dull or exciting, or even take on a different meaning. And the repeated use of words can turn even the most-exciting thoughts into eyelid-closers.

Because of this, one of the most-important tools a writer has, is a "thesaurus" which is a collection of words arranged according to the ideas they are meant to express. The author looks up the word he is considering and the thesaurus suggests synonyms. For example, if you want to avoid using the word "impair" four times in a short sentence, a thesaurus will suggest such words as "damage," "hurt," "harm," "injure," "mar," "prejudice," "tarnish," and perhaps a handful of others if the thesaurus is sufficiently large.

Writers find it difficult to create text at lightning speed on a word processor and then have to stop and go through the pages of a thesaurus to locate a suitable synonym. To meet the pace of the electronic age, the *electronic thesaurus* was created which allows the user to call up synonyms from the word processing program. One of the best we've seen, and the easiest to use, is WORD FINDER, designed for use with WordStar, WordStar 2000, Multimate, Word Perfect, pfs:WRITE, Microsoft Word, and Easy Writer 2. We tested the WordStar version because WordStar remains the most-popular word processor.

WORD FINDER consists of a 30K control program which is loaded into RAM prior to the word processor and a 90,000 word dictionary that requires 157K of disk storage. In a two-drive system, the thesaurus' dictionary must be on the same disk as the word processor. If you're using WordStar either MailMerge or the spelling checker can't be on the same disk. If you want direct access of the thesaurus, a spelling checker and MailMerge, the best arrangement is a hard disk or a RAMdisk for the thesaurus' dictionary.

The program responds to 9000 keywords which can call up an average of ten synonyms each: It means you may get anywhere from one to 50 synonyms for each keyword.

WORD FINDER works at "lightning" speed whether running from a hard disk, a floppy or a RAMdisk. To use the thesaurus while composing a document, you mark a word by placing the cursor on *any* character and press a control key (which you can pre-program). WORD FINDER creates a window on the screen with a list of synonyms. If a suitable synonym is displayed, you move the cursor in the window to the synonym, press RETURN: The synonym substitutes for the marked word, the window vanishes and the word processing display is restored to full size. If there is no direct synonym the window displays the alphabetically-closest spelling of 30 words and the selection process is repeated, only this time it's for the words in the window. You can call up the synonyms for any of the 30 words, and pressing the RETURN key installs the selected synonym into the word processing text. Even if the window doesn't show the desired word or a close synonym there's a good chance that something in the window will suggest precisely what's needed. In this instance, you simply type it into the word processing text.

Obviously, a 90,000 word thesaurus is not equal to a printed version, but WORD FINDER is done well: We had few omissions for commonly-used words. While you might have to refer to a printed version, there is no question that WORD FINDER is a major enhancement for a personal computer's word processor.

Although WORD FINDER can be installed only once—for your particular word processor—the working program isn't protected and you can make as many copies as you like; you simply cannot reinstall the program for another word processor. WORD FINDER automatically determines whether your monitor is color or monochrome from the computer's monitor adapter bit and sets itself accordingly. However, if you are driving a monochrome monitor from a color adapter's composite video output the program will assume you're using a color monitor and key on the color adapter, and the display will appear as garbage. If this happens, run the DOS's MODE BW80 before you load WORD FINDER.

WORD FINDER is priced at $129.95 for both PC/MS-DOS and CP/M computers. It is available direct from Writing Consultants, 11 Creek Bend Drive, Fairport, NY 14450. If you have any questions, phone them at 1(716) 377-0130.◀CD▶

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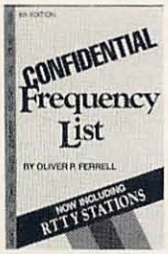


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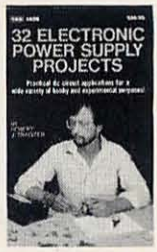


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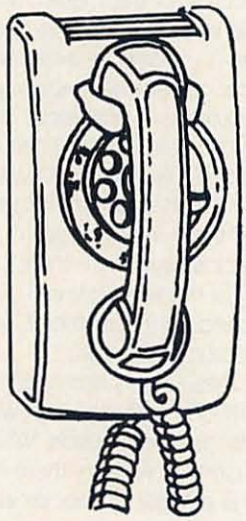

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# USING A Ti-99 KEYBOARD ON A SINCLAIR ZX-81

*You push the middle key down,*
*and the signals go round and round,*
*whoa-ho-ho-ho, ho-ho.*

**Robert Grosblatt**

■The Sinclair ZX-80 and ZX-81 got more people hooked on computers than any machine ever made. For under a hundred bucks you could connect it to a TV, power it up, and find out what computers were about. If you were interested you moved to a bigger machine. If not, it was worth it to satisfy your curiosity.

Even though technology has increased, prices have decreased, and the lowly Sinclair is no more, the fact remains that it's still a powerful machine. Now that it's available on the surplus market for under twenty bucks, what was a good deal has become a bargain.

The biggest drawback to the Sinclair is the membrane keyboard. Not only is it a pain to use but, unless you're gentle with it, it breaks. Replacing the keyboard is a good idea but it seems ridiculous to spend some $50 on a keyboard for a twenty dollar computer. Well, things are looking better.

When Texas Instruments dropped the TI-99/4A, a huge inventory of keyboards were dumped on the surplus market. Modifying them for use on the Sinclair is easy...easier, in fact, than adapting some of the more expensive keyboards. In order to understand what has to be done, let's take a look at the Sinclair.

## The Sinclair

Both the Sinclair and the TI use a simple matrix-type keyboard. This means that each key returns a unique row and column code every time the computer looks at the keyboard to find out which key was pressed. Unfortunately, these keyboard codes have nothing to do with standard ASCII. However, TI's oddball keycodes are so close to Sinclair's oddball codes that it only requires minor keyboard surgery to make them the same.

**Sinclair Keyboard Horizontal Grouping Showing Connector Numbers**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *#8* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | #6 |
| *#7* | Q | W | E | R | T | Y | U | I | O | P | #4 |
| *#5* | A | S | D | F | G | H | J | K | L | ENT | #2 |
| *#3* | SHFT | Z | X | C | V | B | N | M | . | SPC | #1 |

**Sinclair Keyboard Vertical Grouping Showing Connector Numbers**

| *#9* | *#10* | *#11* | *#12* | *#13* | *#13* | *#12* | *#11* | *#10* | *#9* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| Q | W | E | R | T | Y | U | I | O | P |
| A | S | D | F | G | H | J | K | L | ENT |
| SHFT | Z | X | C | V | B | N | M | . | SPC |

**TI Keyboard Horizontal Grouping Showing Connector Numbers**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *#9* | LCK | FCTN | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | | #14 |
| *#6* | | CNRL | Q | W | E | R | T | Y | U | I | O | P | ENT | #15 |
| *#13* | | SHFT | A | S | D | F | G | H | J | K | L | ; | SPC | #12 |
| *#5* | | | Z | X | C | V | B | N | M | , | . | / | = | #11 |

**TI Keyboard Vertical Grouping Showing Connector Numbers**

| *#10* | *#4* | *#8* | *#3* | *#2* | *#1* | *#7* | *#7* | *#1* | *#2* | *#3* | *#8* | *#4* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LCK | FCTN | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | |
| | CTRL | Q | W | E | R | T | Y | U | I | O | P | ENT |
| | SHFT | A | S | D | F | G | H | J | K | L | ; | SPC |
| | | Z | X | C | V | B | N | M | , | . | / | = |

**FIG. 1—COMPARING THE LAYOUTS of the two keyboards. Both have eight horizontal sections but the TI has two extra vertical sections.**

In Figure 1 you can compare the layout of the two keyboards. The first thing you should notice is that while both keyboards have eight horizontal sections, the TI has two extra vertical sections. One of them, #10, is for "Alpha Lock" and the other, #4, contains most of the operator keys. Figure 2 shows you how these section numbers relate to the connectors going from the keyboard to the computer's motherboard.

There are a couple of ways to go about adapting the TI keyboard to the Sinclair. The most elegant is to design some circuitry that converts TI code to Sinclair code. Put the translation tables in an EPROM and the circuit does everything for you. This lets you add goodies like auto repeat, macros, and function keys. After all, the TI keyboard has seven extra keys to play around with. The disadvantage is that you have to design circuitry, build a board, and burn EPROMs.

The easiest way is to do a bit of cutting and pasting to the TI board to make it put out the codes the Sinclair expects to see. Most of the extra keys will go to waste but it's less work. Especially since the two keyboards have really similiar arrangements to start with. Figure 3 is a list of the changes that have to be made to the TI keyboard. There are fourteen keys that have to be moved. The "Alpha Lock" key, a push on - push off switch, can be isolated and put in parallel with the "Shift" key to give a quick and dirty Shift lock.

Unfortunately, the rest of the TI's extra keys won't do anything at all. They can't be used for extra characters because the ZX-81 won't recognize any additional keycodes. All you can do is put them in parallel with other keys to make the keyboard more convenient to use. Once you've made these changes to the TI keyboard all that's left is making the connections to the ZX-81 motherboard.

Turn the ZX-81 upside down and locate the five screws that hold the case together. Three of them are located under the rubber feet as shown in Figure 4. Once the case is open, lift out the mother board by removing the two retaining screws, pull the two keyboard connectors from their sockets and tape them out of the way on the underside of the case. Solder 12-

**Sinclair Keyboard Connectors Viewed from the Back of the Keyboard**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | | — | — | — | — | — |
| — | — | — | — | — | — | — | — | | — | — | — | — | — |
| — | — | — | — | — | — | — | — | | — | — | — | — | — |
| — | — | — | — | — | — | — | — | | — | — | — | — | — |

Vertical Connectors — Horizontal Connectors

**TI Keyboard Connectors Viewed from the Back of the Keyboard**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |
| — | — | — | — | — | — | — | — | — | — | — | — | — | — | — |

Horizontal Connectors = 5, 6, 9, 11, 12, 13, 14, 15
Vertical Connectors = 1, 2, 3, 4, 7, 8, 10

**FIG. 2—HOW THE SECTION NUMBERS relate to the connectors from the keyboard to the computer's motherboard.**

**Cut and Paste Guide for Adapting the TI Keyboard at the Sinclair**

| Key | Original Location | New Location |
|---|---|---|
| B | Horizontal #15 | Horizontal #11 |
| SPC | Horizontal #12 | Horizontal #11 |
| SHFT | Horizontal #13 | Horizontal #5 |
| ENT | Horizontal #15 | Horizontal #12 |
| LOCK | Horizontal #9 | Horizontal #11 |
| Z | Vertical #8 | Vertical #3 |
| X | Vertical #3 | Vertical #2 |
| C | Vertical #2 | Vertical #1 |
| V | Vertical #1 | Vertical #7 |
| N | Vertical #7 | Vertical #1 |
| M | Vertical #1 | Vertical #2 |
| ENT | Vertical #4 | Vertical #8 |
| SPC | Vertical #4 | Vertical #8 |
| SHFT | Vertical #4 | Vertical #8 |
| LOCK | Vertical #10 | Vertical #8 |

**TI Keyboard to ZX-81 Motherboard Connection Guide**

| T1 Keyboard | ZX-81 Motherboard |
|---|---|
| 1 | 12 |
| 2 | 11 |
| 3 | 10 |
| 4 | NOT USED |
| 5 | 3 |
| 6 | 7 |
| 7 | 13 |
| 8 | 9 |
| 9 | 8 |
| 10 | NOT USED |
| 11 | 1 |
| 12 | 2 |
| 13 | 5 |
| 14 | 6 |
| 15 | 4 |

**FIG. 3—A LIST OF CHANGES to be made in the TI keyboard. A total of fourteen keys have to be moved.**

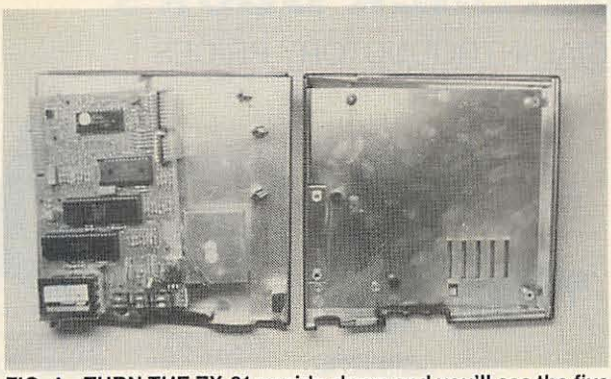

**FIG. 4—TURN THE ZX-81 upside-down and you'll see the five screws that hold the case together.**

inch lengths of hookup wire to each of the thirteen keyboard connectors on the bottom of the motherboard. You can remove the original keyboard connectors but it's easier to lap solder directly to the motherboard. The same is true of the TI keyboard.

As you can see from Figure 5, I used male and female DB-25 connectors to connect the TI keyboard to the Sinclair motherboard but you can connect them directly together. Since the ZX-81 motherboard is smaller than the keyboard, you can get rid of the case and put the whole thing together in a small utility case. If so, use an aluminum case and connect the case to the housing around the RF modulator. The Sinclair has a problem with RF and you'll have trouble with the video if you use a plastic box.

I can't show you exactly how to do the surgery on the keyboard. TI used several manufacturers to make the boards and though all the keyboards are functionally the same, the traces are different from manufacturer to manufacturer. As long as you identify the switches on the printed circuit board you should have no trouble altering it to use on the Sinclair.

When you finish, don't throw away the old Sinclair keyboard. You can cut out the key tops with a hobby knife and glue them to the tops of the keys on the TI keyboard. A new keyboard is nicer if the keys are properly labeled.

**FIG. 5—MALE AND FEMALE DB-25 connectors connect the TI keyboard to the Sinclair motherboard.**

**Sinclair Keyboard Keycodes**

| Key Location Pressed | Keycode | Register |
|---|---|---|
| None | FF | L |
| Horizontal #1 | 7F | L |
| Horizontal #2 | BF | L |
| Horizontal #3 | FE | L |
| Horizontal #4 | DF | L |
| Horizontal #5 | FD | L |
| Horizontal #6 | EF | L |
| Horizontal #7 | FB | L |
| Horizontal #8 | F7 | L |
| None | FF | H |
| Vertical #9 | FD | H |
| Vertical #10 | FB | H |
| Vertical #11 | F7 | H |
| Vertical #12 | H | |
| Vertical #13 | DF | H |

If the SHIFT key is pressed with another key bit 0 is reset to 0 in the H register so that FF = FE, FD = FC, F7 = F6, etc.

**FIG. 6—HERE ARE THE CODES put out by the Sinclair keyboard. This will be of great help if you're building translation circuitry.**

### Translation circuitry

If you're set on building translation circuitry you'll find Figure 6 helpful. I've listed the codes put out by the Sinclair keyboard. The keyboard scanning routine in the Sinclair ROM (located at 022B hex) returns with the keycode in the Z-80's HL register. The key's row (horizontal) location is stored in L and the column (vertical) location is stored in H. Once the computer has the complete keycode, it uses a routine located at 07BD hex to translate the code into the character it represents. The lookup table is stored from 007E to 00CB hex.

Building circuitry to do the job means bringing power and ground out from the motherboard. Since the data bus has to be 13 bits wide, you'll have to think about the 8 bit limitation of the EPROM. There are two ways of handling the problem. You can use two locations in the EPROM to store each keycode and let your circuit clock the data out in order or use two EPROMs to widen the bus to 16 bits. This last approach is easier and even though it means burning two EPROMs it will cut the circuitry needed down to a much more managable size.

The Sinclair is a great first computer and a good choice for a dedicated controller. Once you get your software straight, you can burn the program into an EPROM and replace the ZX-81's 2k RAM chip with the EPROM. Although I've been skimpy on the details of designing the EPROM circuitry needed to do a nifty keyboard adaptation, if there's enough interest I can deal with it much more thoroughly in a separate article.◀CD▶

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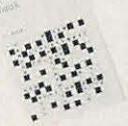

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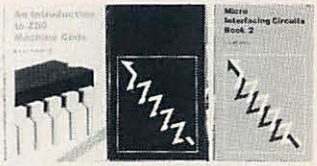


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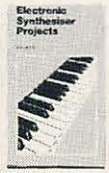
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# REMOTE POWER CONTROLLER FOR YOUR COMMODORE-64

*Couple a wireless remote and your computer. Instant automation!*

**Chandler Sowden**

■One of the useful things a home computer can do is control things around the house. Unfortunately, this usually involves stringing control wires from the computer to the device being controlled.

Enter the home wireless remote control system, as manufactured and sold by BSR and Radio Shack. With this system, lights and appliances can be controlled (manually) from a central location without wires.

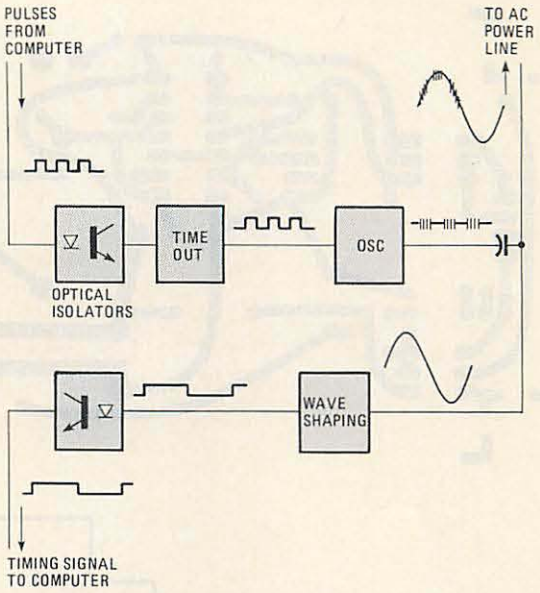


**FIG. 1—BLOCK DIAGRAM reveals simplicity of the circuit. Opto-isolators keep AC out of the computer.**

## How it works

The wireless remote modules respond to a pulse coded 125KHz signal placed on the AC power line. The pulses occur in groups of three and are synchronized to the power line. As shown in Figure 1, the device consists of a 60 Hz wave shaping circuit, an

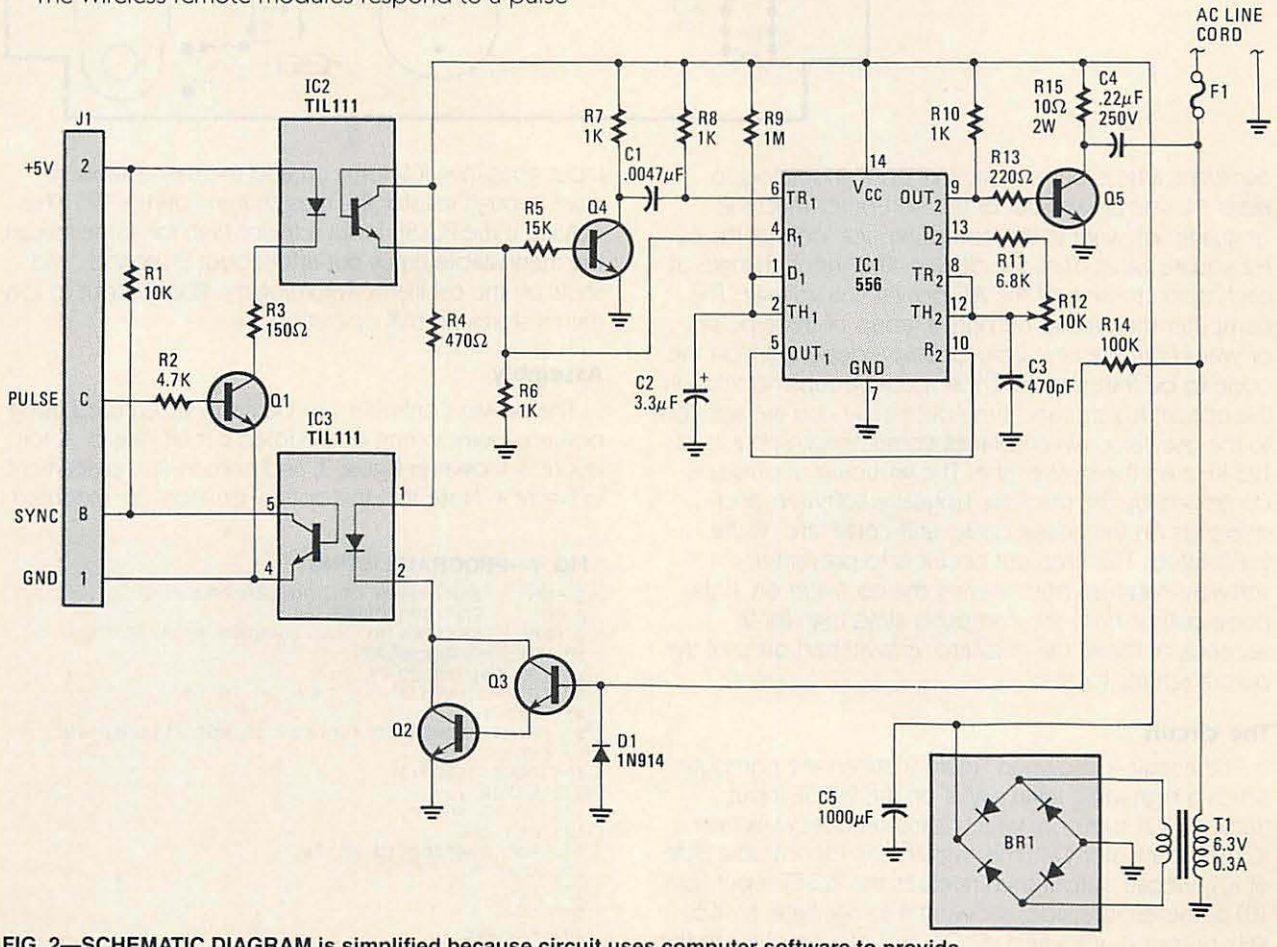


**FIG. 2—SCHEMATIC DIAGRAM is simplified because circuit uses computer software to provide many of the necessary functions. Refer to text for in-depth explanation.**

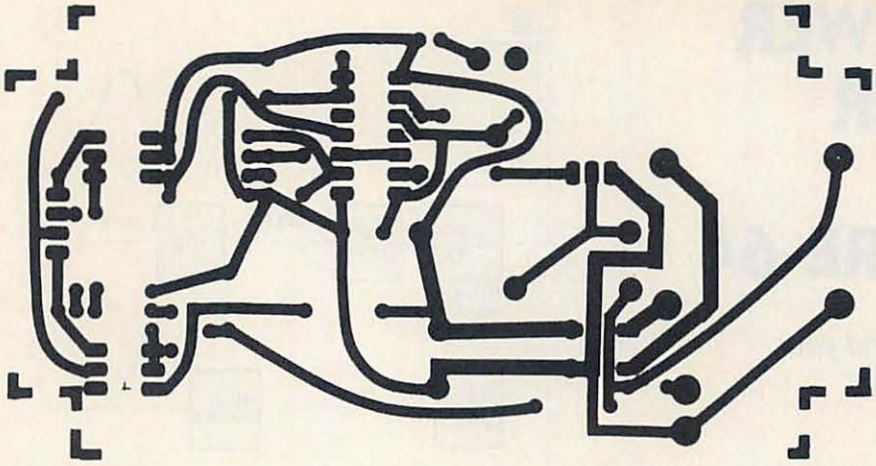

**FIG. 3—HERE'S THE FOIL PATTERN for those of our readers who desire to do their own circuit-board etching.**

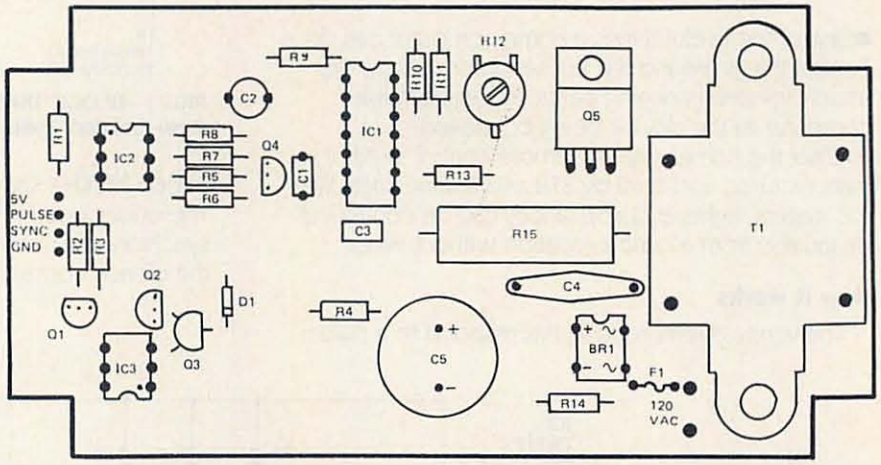


**FIG. 4—...AND WHEN YOU'VE GOT THE BOARD etched, here's where all the parts go.**

oscillator, a time-out circuit, and optical isolators to keep AC line power out of the computer. Machine language software in the computer first looks at the 60 Hz square wave from the device. This input changes at each zero crossing of the AC power line voltage. The computer then either outputs a group of three pulses or waits until the next zero crossing, depending on the code to be transmitted. These pulse groups go through the optical isolator and time-out circuit and are applied to the oscillator, which places corresponding bursts of 125 KHz on the power line. The grouping of pulses is controlled by the machine language software, and depends on the house code, unit code, etc., to be transmitted. The time-out circuit is to prevent a software hang-up from leaving the oscillator on. If the pulse output from the computer stays high for 2 seconds or more, the oscillator is switched off until the output returns to zero.

### The circuit

The circuit is shown in Figure 2. When the computer sends a high logic level signal on the PULSE input, transistor Q1 turns on, which turns on optical isolator IC2 and transistor Q4. This triggers the monostable side of IC1, whose output then releases the RESET input (pin 10) of the astable side, allowing it to oscillate. Its 125 KHz output is amplified by Q5 and then applied to the AC power line through capacitor C4. When the PULSE input goes low, IC2 turns off and the monostable is reset through resistor R6, thus shutting off the 125 KHz output. If the PULSE input remains high for some reason, the monostable times out after about 2 seconds and shuts off the oscillator. Returning the PULSE input to low then restores normal operation.

### Assembly

The power controller can be easily assembled using point-to-point wiring or a printed circuit board. A foil layout is shown in Figure 3, and component placement in Figure 4. Note that the optical isolators are mounted

**FIG. 7—PROGRAM LISTING.**

```
1 REM     BSR POWER CONTROLLER PROGRAM
2 REM     FOR COMMODORE 64
3 REM     WRITTEN BY G.C. SOWDEN 6/14/85
10 LET P=PEEK(56577)
20 FOR I=1 TO 20
30 IF PEEK(56577)<>P THEN GO TO 100
40 NEXT I
50 PRINT "POWER CONTROLLER IS NOT PLUGGED IN"
60 END
100 POKE 56579,1
102 GOSUB 109
104 GO TO 600
109 RESTORE
110 FOR A=49152 TO 49336
120 READ D
130 POKE A,D
140 NEXT A
142 RETURN
145 REM BSR
150 DATA 169,2,141,42,192
```

```
160 DATA 32,47,192,173,43,192
170 DATA 141,44,192,32,68,192
180 DATA 173,45,192,208,3,32,94,192
190 DATA 173,46,192,141,44,192,32,68
200 DATA 192,206,42,192,208,222,96,0,0
210 DATA 0,105,0,0,171
220 REM SC
230 DATA 32,94,192,169,3
240 DATA 141,67,192,32,120,192
250 DATA 206,67,192,208,248,32,94,192
260 DATA 96,0
270 REM BITS
280 DATA 169,8,141,93,192,14,44,192
290 DATA 144,6,32,120,192,76,87,192
300 DATA 32,94,192,206,93,192,208,237
310 DATA 96,0
320 REM TZ
330 DATA 169,0,141,119,192,206,119,192
340 DATA 208,251
350 DATA 173,1,221,141,119,192
360 DATA 173,1,221,205,119,192,240,248
370 DATA 96,0
380 REM T1
390 DATA 169,3,141,160,192,173,161,192
400 DATA 9,1,141,1,221,162,186,202
410 DATA 208,253,173,161,192,141,1,221
420 DATA 169,183,141,162,192
430 DATA 206,162,192,208,251
440 DATA 206,160,192,208,222,96,0,0,0
450 REM UNIT CODES
460 DATA 105,169,89,153,86,150,102,166
470 DATA 106,170,90,154,85,149,101,165
480 DATA 179,181,173,171,205,203
600 LET N=100
610 DIM T(N),U(N),F(N),S$(16)
620 FOR I=1 TO N
630 READ T(I),U(I),F(I)
635 IF T(I)>2359 THEN GO TO 1000
640 NEXT I
650 DATA 1201,1,1
651 DATA 1202,1,2
999 DATA 9999,0,0
1000 LET C$="A"
1010 PRINT "TIME(HHMM)"
1020 INPUT T$
1030 LET TI$=T$+"00"
1040 LET T$=LEFT$(TI$,4)
1060 LET H$=LEFT$(T$,2)
1070 LET M$=RIGHT$(T$,2)
1090 LET T1=VAL(T$)
1100 FOR I=1 TO N
1105 IF T(I)>2359 THEN GO TO 1160
1110 IF T(I)<>T1 THEN GO TO 1150
1120 LET U1=U(I)
1130 LET F1=F(I)
1140 GOSUB 8000
1150 NEXT I
1160 GOSUB 7000
1170 LET T0$=LEFT$(TI$,4)
1180 IF PEEK(197)<>64 THEN GO TO 1220
1190 IF T$=T0$ THEN GO TO 1170
1200 LET T$=T0$
1210 GO TO 1060
1220 IF PEEK(197)<>64 THEN GO TO 1220
1230 INPUT D$
1240 INPUT "TYPE DEVICE NUMBER:";U1
1250 IF U1=0 THEN END
1260 INPUT "FUNCTION?(TYPE 1 FOR ON, 2 FOR OFF)";F1
1270 GOSUB 8000
1280 GO TO 1160
7000 PRINT "{CLR}"
7010 PRINT H$;":";M$
7020 PRINT
7030 PRINT "DEVICE NUMBER AND STATUS:"
7040 PRINT
7050 FOR K=1 TO 16
7060 PRINT S$(K),
7065 NEXT K
7070 PRINT
7080 PRINT "PRESS RETURN FOR MANUAL CONTROL"
7090 RETURN
8000 LET S1$=" OFF"
8030 IF F1=1 THEN LET S1$=" ON "
8040 LET S$(U1)=STR$(U1)+S1$
8050 GOSUB 9000
8060 RETURN
9000 GOSUB 109
9002 POKE 49195,PEEK(49250+ASC(C$))
9008 POKE 49198,PEEK(49314+U1)
9010 POKE 49197,1
9020 SYS 49152
9030 FOR J=1 TO 10
9031 NEXT J
9032 IF F1<5 THEN GO TO 9050
9034 LET F2=2*(F1-100*INT(F1/100))
9036 LET F1=INT(F1/100)
9040 POKE 49153,F2
9050 POKE 49198,PEEK(49330+F1)
9060 POKE 49197,0
9070 SYS 49152
9075 POKE 49153,2
9080 PRINT U1,F1
9082 FOR J=1 TO 200
9084 NEXT J
9090 RETURN
```

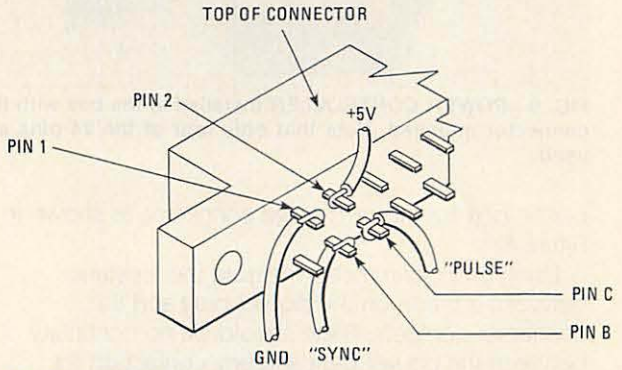


**FIG. 5—WIRING FOR THE CONNECTOR is shown above. Provide good mechanical connections for all leads and then carefully solder.**

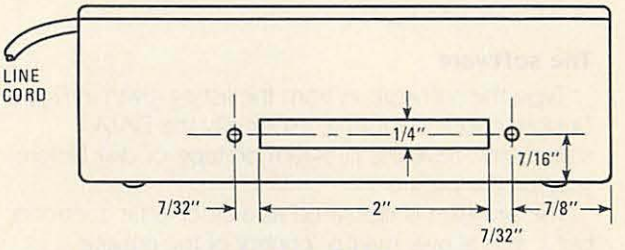


**FIG. 6—DIMENSIONS ARE PROVIDED here for openings in the connector. See text for additional explanation.**

facing opposite directions. You'll have to cut openings for the AC cord and the computer card-edge connector. The connector mounts on the side of the box, and it than plugs into the Commodore User Port.

After the components are in place, install the power cord. Solder hookup wire to the card-edge connector, as shown in figure 5. Cut a rectangular opening in the

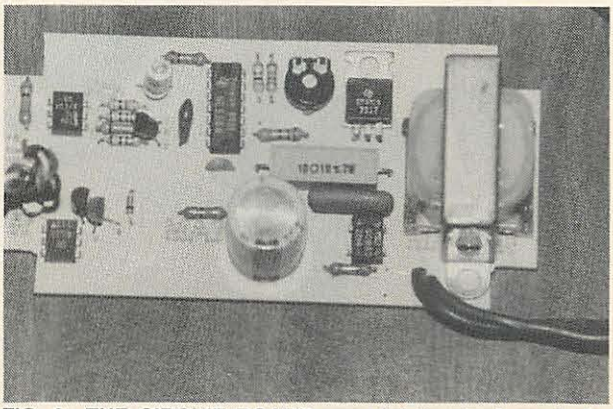

**FIG. 8—THE CIRCUIT BOARD completely wired, ready for installation in the box.**

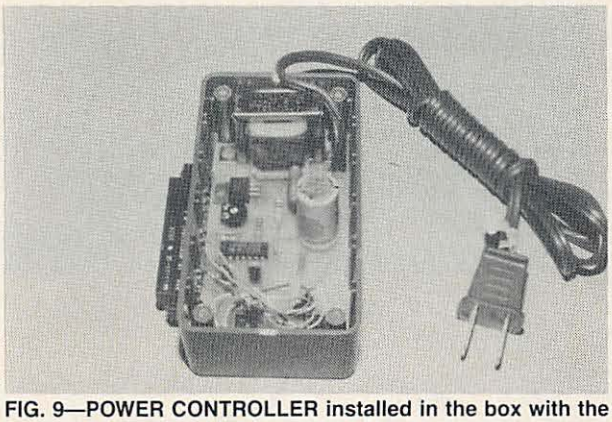

**FIG. 9—POWER CONTROLLER installed in the box with the connector attached. Note that only four of the 24 pins are used.**

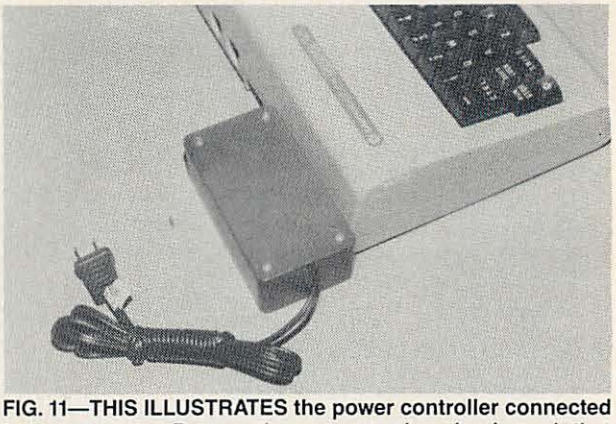

**FIG. 11—THIS ILLUSTRATES the power controller connected to the computer. Be sure the connector location is such that the box does not cover the opening for the cassette interface.**

plastic box for the card-edge connector, as shown in Figure 6.

Using a volt-ohmmeter, measure the resistance between a blade on the power plug and the connector contacts. There should be no continuity between the power plug and any contact on the connector. Next, plug the unit into a wall outlet and CAREFULLY measure the DC voltage at the output of the bridge rectifier. It should be about 8 volts. Be careful, because most of the components have power line voltage on them.

### The software

Type the software in from the listing given in Figure 7. Double check the listing, especially the DATA statements. Save the program on tape or disk before you run the program.

The program is designed as a clock-time controller, but it also allows manual control of the remote modules from the computer keyboard. The program allows up to 100 on or off operations in a day, but this could be changed by changing line 600. The desired on/off times are in DATA statements is: (line number) DATA time, unit, code where "code" is a 1 for on, 2 for off. In the program, line 650 means "At 12:01 (24 hour time), turn unit 1, ON (code 1)," while line 651 says "At 12:02, turn unit 1, OFF (code 2)."

The "house code" for the power controller is set at line 1000. Sixteen different house codes are provided,

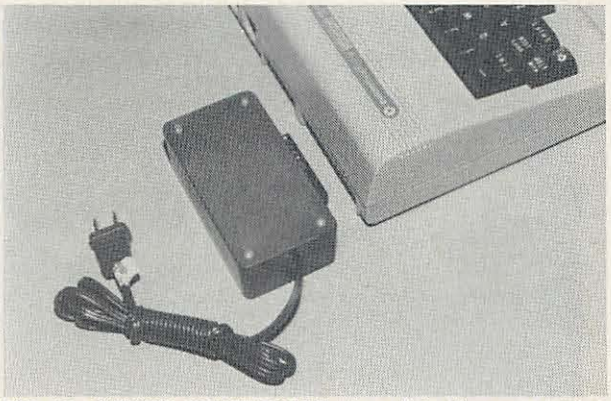

**FIG. 10—POWER CONTROLLER plugs into the user port at the rear of the cabinet.**

in case your neighbor uses a similar system.

Take a remote module, set it to House Code "A" and unit code "1." Plug it in and plug a lamp into it. Run the program. It will then ask for the time. Type in the time in 4-digit, 24-hour format, then return. The program will clear the screen, print a heading, then a line which asks you to "press return for manual control." Press RETURN. It will say "type device number;" type 1 (and return); it will ask "Function? (Type 1 for on, 2 for off)." Type 1 (and return). The lamp should turn on. If it doesn't, try checking the house and unit codes, then check the program for typos. If that doesn't help, then try tweaking potentiometer R12. ◀Ⓓ▶

**PARTS LIST**

**Semiconductors**
BR1—1 ampere, 50V. bridge rectifier
IC1—LM556 dual timer
IC2, IC3—TIL111 (or similar) optical isolator
Q1-Q4—2N3904 or similar transistor
Q5—TIP31 transistor

**Resistors**
(All resistors ¼watt unless otherwise indicated)
R1—10,000-ohm
R2—4700-ohm
R3—150-ohm
R4—470-ohm
R5—15,000-ohm
R6-R8, R10—1000-ohm
R9—1-megohm
R11—6800-ohm
R12—10,000-ohm ⅛ watt potentiometer
R13—220-ohm
R14—100,000-ohm
R15—10-ohm, 2 watts

**Capacitors**
(All capacitors at least 16V.)
C1—.0047μF.
C2—3.3μF. C3—470pF
C4—.22μF.
C5—1000μF.

**Miscellaneous parts and equipment**
F1—¼ a. fuse (see text)
J1—Card-edge connector, Texas Instruments No. H411121-12 (available from Digi-Key Corp., P. O. Box 577, Thief River Falls, MN 56701-9988)
T1—6.3V 300mA transformer
Line cord, box, etc.

# COMPUTERIZED POWER SUPPLY COMPONENT SELECTION

*Let your computer choose your power-supply components.*

**Jack Cunkelman**

■As critical as a power supply may be, it seems to be the last thing to be considered. Only after a project is working, using the bench supply, do we think about the power supply and how we are going to fit it into the enclosure. This is where this program comes into play. It will make component selection faster and easier.

A power supply can consist of a battery or a transformer/rectifier assembly to power it from 120 volt AC sources. The linear type of power supply seems to be the most popular transformer/rectifier combination and that is what we will deal with here.

There are only a few ways to obtain DC power from AC sources using linear power supplys. One of the following three circuits are used by most experimenters: full wave bridge, full wave-center tapped, and full wave bridge -center tapped. We will limit ourselves to these three circuits.

Once the program is running there are two options available, output to the screen or output to a printer. The printer output will generate a list of component rating values for various power supply voltages and configurations.

The screen option treats the transformer as the variable element. Plugging in the values from those transformers in your "junk box" will enable you to quickly determine if they can be used or not. The screen display also deals with current ratings. A 0 entry, when a question is asked will return you to the menu. A 0 entry on the menu will stop the program.

All ratings are conservative for cool running, reliable operation. If you cannot find components with the exact rating, always step up to the next highest rated component available.

FULL WAVE BRIDGE
CAPACITOR INPUT FILTER

| TRANSFORMER VOLTAGE(RMS) | DC VOLTS | DIODE PIV | CAPACITOR VOLTAGE |
|---|---|---|---|
| 5 | 6 | 12 | 7 |
| 6 | 8 | 16 | 10 |
| 7 | 9 | 18 | 11 |
| 8 | 10 | 20 | 13 |
| 9 | 12 | 24 | 15 |
| 10 | 13 | 26 | 16 |
| 11 | 14 | 28 | 18 |
| 12 | 16 | 32 | 20 |
| 13 | 17 | 34 | 22 |
| 14 | 18 | 36 | 23 |
| 15 | 20 | 40 | 26 |
| 16 | 21 | 42 | 27 |
| 17 | 22 | 44 | 28 |
| 18 | 24 | 48 | 31 |
| 19 | 25 | 50 | 32 |
| 20 | 26 | 52 | 33 |
| 21 | 28 | 56 | 36 |
| 22 | 29 | 58 | 37 |
| 23 | 30 | 60 | 39 |
| 24 | 32 | 64 | 41 |
| 25 | 33 | 66 | 42 |
| 26 | 34 | 68 | 44 |
| 27 | 36 | 72 | 46 |
| 28 | 37 | 74 | 48 |
| 29 | 38 | 76 | 49 |
| 30 | 40 | 80 | 52 |
| 31 | 41 | 82 | 53 |
| 32 | 43 | 86 | 55 |
| 33 | 44 | 88 | 57 |
| 34 | 45 | 90 | 58 |
| 35 | 47 | 94 | 61 |
| 36 | 48 | 96 | 62 |
| 37 | 49 | 98 | 63 |
| 38 | 51 | 102 | 66 |
| 39 | 52 | 104 | 67 |
| 40 | 53 | 106 | 68 |
| 41 | 55 | 110 | 71 |
| 42 | 56 | 112 | 72 |
| 43 | 57 | 114 | 74 |
| 44 | 59 | 118 | 76 |
| 45 | 60 | 120 | 78 |
| 46 | 61 | 122 | 79 |
| 47 | 63 | 126 | 81 |
| 48 | 64 | 128 | 83 |
| 49 | 65 | 130 | 84 |
| 50 | 67 | 134 | 87 |
| 51 | 68 | 136 | 88 |
| 52 | 69 | 138 | 89 |
| 53 | 71 | 142 | 92 |
| 54 | 72 | 144 | 93 |
| 55 | 73 | 146 | 94 |

```
10 CLS
20 REM POWER SUPPLY SPECIFICATION PR
OGRAM
30 REM BY JACK CUNKELMAN
40 REM JUNE 1985
50 INPUT "DO YOU WANT SCREEN DISPLAY
 (S) OR PRINTER OUTPUT (P)";D$
60 IF D$="S" THEN 80
70 IF D$="P" THEN 500
75 PRINT "INPUT ERROR" : GOTO 50
80 CLS
85 PRINT"POWER SUPPLY TYPE"
90 PRINT"     FULL WAVE BRIDGE (1)"
100 PRINT"     FULL WAVE CENTER TAP (
2)"
110 PRINT"     FULL WAVE BRIDGE CENTE
R TAP (3)"
120 PRINT" ALL USING CAPACITOR INPUT
 FILTERING"
130 INPUT" SELECT TYPE 1 , 2 , 3 OR
0 TO QUIT";T
135 IF T=0 THEN END
140 ON T GOTO 1000,2000,3000
150 GOTO 80
500 CLS
510 PRINT "THE PRINTER OPTION PRINTS
```

```
 A TABLE OF VALUES FOR VARIOUS
        TRANSFORMERS"
520 PRINT "TYPE OF CIRCUIT:"
530 PRINT"     FULL WAVE BRIDGE (1)"
540 PRINT"     FULL WAVE CENTER TAP (
2)"
550 PRINT"     FULL WAVE BRIDGE CENTE
R TAP (3)"
560 PRINT" ALL USING CAPACITOR INPUT
 FILTERING"
570 INPUT" SELECT TYPE 1 , 2 , 3  OR
 0 TO QUIT";T
580 IF T=0 THEN END
590 ON T GOTO 1500,2500,3500
1000 CLS
1010 PRINT"FULL WAVE BRIDGE , CAPACI
TOR INPUT FILTER"
1020 INPUT"TRANSFORMER RMS VOLTAGE";
V
1025 IF V=0 THEN 80
1030 INPUT"TRANSFORMER CURRENT RATIN
G (AMPS)";C
1040 RV=INT((V*.95*1.414)+.04)
1050 DV=INT(2*RV)
1060 CV=INT(1.3*RV)
1070 OC = INT(C/1.8*10)
1080 GOSUB 5000
1090 PRINT V;TAB(21)RV;TAB(31)DV;TAB
(41)CV;TAB(52)OC/10
1100 GOTO 1010
1500 CLS
1510 INPUT"MINIMUM TRANSFORMER VOLTA
GE";M
1522 T$="FULL WAVE BRIDGE"
1524 GOSUB 6000
1530 FOR V = M TO M+50
1540 RV=INT((V*.95*1.414)+.04)
1550 DV=INT(2*RV)
1560 CV=INT(1.3*RV)
1580 LPRINT TAB(8)V;TAB(20)RV;TAB(31
)DV;TAB(41)CV
1590 NEXT V
1600 GOTO 500
2000 CLS
2010 PRINT"FULL WAVE CENTER TAPPED ,
 CAPACITOR INPUT FILTER"
2020 INPUT"TRANSFORMER RMS VOLTAGE (
ENTIRE SECONDARY)";V
2025 IF V=0 THEN 80
2030 INPUT"TRANSFORMER CURRENT RATIN
G (AMPS)";C
2040 RV=INT((V*.95*1.414)+.04)/2
2050 DV=INT(4*RV)
2060 CV=INT(1.3*RV)
2070 DV=INT(4*RV)
2075 OC=INT(C/1.2*10)
2080 GOSUB 5000
2090 PRINT V;TAB(21)RV;TAB(31)DV;TAB
(41)CV;TAB(52)OC/10
2110 GOTO 2010
2500 CLS
2510 INPUT"MINIMUN TRANSFORMER VOLTA
GE (ENTIRE SECONDARY)";M
2520 T$="FULL WAVE CENTER TAP"
2524 GOSUB 6000
2530 FOR V = M TO M+50
2540 RV=INT((V*.95*1.414)+.04)/2
2550 DV=INT(4*RV)
2560 CV=INT(1.3*RV)
2580 LPRINT TAB(8)V;TAB(20)RV;TAB(31
)DV;TAB(41)CV
2590 NEXT V
2600 GOTO 500
3000 CLS
3010 PRINT "FULL WAVE BRIDGE CENTER
TAP,CAPACITOR INPUT FILTER"
3020 INPUT"TRANSFORMER RMS VOLTAGE (
ENTIRE SECONDARY)";V
3025 IF V=0 THEN 80
3030 INPUT "TRANSFORMER CURRENT RATI
NG (AMPS)";C
3040 RV =INT((V*.95*1.414)+.04)/2
3050 DV = INT(4*RV)
3060 CV =INT(1.3*RV)
3070 OC =INT((C/1.8)/2*10)
3080 GOSUB 5000
3090 PRINTV;TAB(18)"+/-"RV;TAB(31)DV
;TAB(41)CV;TAB(49)"+/-"OC/10
3100 GOTO 3010
3500 CLS
3510 INPUT"MINIMUM TRANSFORMER VOLTA
GE (ENTIRE SECONDARY)";M
3520 T$="FULL WAVE BRIDGE CENTER TAP
"
3525 GOSUB 6000
3530 FOR V = M TO M+50
3540 RV = INT((V*.95*1.414)+.04)/2
3550 DV = INT(4*RV)
3560 CV = INT(1.3*RV)
3580 LPRINT TAB(8)V;TAB(19)"+/-"RV;T
AB(31)DV;TAB(41)CV
3590 NEXT V
3600 GOTO 500
5000 PRINT"TRANSFORMER";TAB(20)" DC
";TAB(30)"DIODE";TAB(40)"CAPACITOR";
TAB(52)   "  DC  "
5010 PRINT"VOLTAGE(RMS)";TAB(20)"VOL
TS";TAB(30)" PIV ";TAB(40)"VOLTAGE";
TAB(51)   "CURRENT(AMPS)"
5020 RETURN
6000 LPRINT:LPRINT:LPRINT
6005 LPRINT TAB(20) T$
6010  LPRINT TAB(20)"CAPACITOR INPUT
 FILTER"
6015 LPRINT
6020  LPRINTTAB(5)"TRANSFORMER";TAB(
20)" DC ";TAB(30)"DIODE"TAB(40)"CAPA
CITOR"
6030  LPRINTTAB(5)"VOLTAGE(RMS)";TAB
(20)"VOLTS";TAB(30)" PIV ";TAB(40)"V
OLTAGE"
6035 LPRINT
6040 RETURN
```

The biggest variable seems to be the transformer and how it is rated. I have always been within 10% of the desired output value using the transformer's published ratings.◀Ⓓ▶